REMARKS

The foregoing amendment amends independent claims 1, 9, 20, 42, 64, 66 and 70. Pending in the application are claims 1-14, 16-45, 47-64 and 66-70, of which claims 1, 9, 20, 22, 29, 42, 64, 66, 67 and 70 are independent. Claims 2-8, 22-41, 49-54, 59, 60 and 67-69 are withdrawn from consideration. The following comments address all stated grounds for rejection and place the presently pending claims, as identified above, in condition for allowance.

Independent claims 1, 9, 42, 64, 66 and 70 are amended to change the phrase "such that none of the liquid enters the fluid interface port" to ---such that none of the liquid (or first fluid) in the microchannel enters the fluid interface port when the virtual wall is formed---. The amendment clarifies that the virtual wall has zero dead volume, i.e., the virtual wall capillary forces prevent liquid in the microchannel from entering the fluid interface port, as set forth on page 9, lines 6-10 and on page 22, lines 4-23 of the application as originally filed.

Independent claim 1 is also amended to specify that the meniscus of the first fluid formed at the fluid interface port is co-planar with the sidewall.

Independent claim 9 is also amended to specify that upon filling of the microchannel, a virtual wall fluid interface port comprising a meniscus of the first fluid is formed in the fluid interface port, and that the meniscus is co-planar with the side wall.

Independent claim 20 is amended for purposes of clarity to remove the term "when" in line 17 and to change the phrase "second aperture" to ---second filling aperture--- in line 18. Claim 20 is also amended to include the phrase ---and a virtual wall fluid meniscus is formed in each of the first filling aperature and the second filling aperture--- at the end of the claim. *No new matter is added.*

Amendment and/or cancellation of the claims is not to be construed as an acquiescence to any of the objections/rejections set forth in the instant Office Action, and was done solely to expedite prosecution of the application. Applicant reserves the right to pursue the claims as originally filed, or similar claims, in this or one or more subsequent patent applications.

35 U.S.C. §112 REJECTIONS

In the Office Action, the Examiner rejects claims 1, 9-14, 16-21, 42-45, 47, 48, 55-58, 61-64, 66, and 70 under 35 USC §112, first paragraph, as failing to comply with the written description requirement. Applicants submit that the subject matter of the claims is sufficiently described in the specification as originally filed, and request that the rejection under 35 USC §112, first paragraph be reconsidered and withdrawn.

Regarding the assertion that the specification does not teach "none of the liquid entering the fluid interface port", Applicants submit that adequate support is found in the specification. The claim specifies that no fluid enters the port *from the microchannel*, *after* the virtual wall is formed. A fluid interface port in which none of the liquid from the microchannel entering the fluid interface port is shown in Figure 9A and described on page 21, lines 4-28. In Figure 9A, the fluid interface port has "zero dead volume i.e. no liquid is retained in the fluid interface port 17". In addition, page 9, lines 7-10 specify that the aperture forming the fluid interface port "has suitable cross sectional dimensions such that capillary forces retain liquid within the microchannel. The virtual wall is defined by the meniscus of the liquid in the opening, which essentially replaces the side wall of the microchannel so as to not substantially affect or influence fluid flow through the microchannel." As also set forth in the specification, the virtual wall created in the fluid interface port "seal[s] liquid inside of the microchannel through a range of pressures in the microchannel." (see Figures 3a and 3b.) Therefore, the recitation of no liquid from a microchannel entering a fluid interface port when the virtual wall is formed is sufficiently supported in the original specification.

The Examiner also rejects claims 9-14 and 16-21 under the second paragraph of 35 U.S.C. §112 for failing to particular point out and distinctly claims the invention. The claims now specify that none of the liquid or first fluid from the microchannel enters the fluid interface port when the virtual wall is formed. The claims do not refer to the time when fluid traverses the fluid interface port in order to fill the microchannel. Rather, the claims specify that *after* the microchannel is filled, and the virtual wall is formed, the virtual wall seals the channel and prevents fluid from entering back into the fluid interface port.

Regarding claim 20, Applicants have amended the claim to remove the term "when" and to provide antecedent basis for "second aperture" in line 18.

For at least these reasons, Applicants request reconsideration and withdrawal of the 35 U.S.C. §112 Rejection.

35 U.S.C. §103 REJECTIONS

In the Office Action, the Examiner rejects claims 1, 9-14, 16-21, 42-45, 47, 48, 55-58, 61-64, 66 and 70 under 35 U.S.C. §103. Applicants traverse the rejection and submit that the pending claims distinguish patentably over the cited references.

Obviousness Rejections over Heller, McCormick, Amigo, Howitz, Columbus (4,302,313), Bjornson et al., Columbus (4,426,456), Kopf-Sill, Swierkowski, Sundberg and/or Swedberg

Applicants maintain that any combination of the Heller reference, the McCormick reference, the Amigo reference, the Howitz reference, the Columbus '313 reference, the Columbus '456 reference, the Bjornson reference, the Kopf-Sill reference, the Swierkowski reference, the Swedberg reference and/or the Sundberg reference fail to render the claims obvious. As previously set forth, Applicants assert that the claims distinguish patentably over the cited references, either alone or in any combination. In addition, the claim amendments further distinguish the claims over the cited references, either alone or in any combination. The cited references, alone or in any combination, fail to disclose the subject matter of the claimed invention.

Independent claims 1, 9, 20, 42, 64, 66 and 70 specify that none of the liquid in a filled microchannel enters back into the fluid interface port when the virtual wall is formed upon filling of the microchannel. The filling of the microchannel creates the virtual wall meniscus at the fluid interface port, which replaces a removed portion of a side wall of the microchannel, a feature not disclosed in the cited references. The virtual wall essentially seals the fluid interface port, preventing liquid that fills the microchannel from entering the fluid interface port and resulting in a direct fluid interface with zero dead volume, in contrast to the cited references.

The cited references show fluid entering into the ports, in contrast to the claimed invention. In addition, because the cited references *require* a larger dead volume in an injection region in order to properly operate, this recitation is not only not disclosed in the cited references, but also not obvious from the teachings of these references.

In addition, Applicants maintain that the cited references, alone or in any combination, do not disclose a device having a fluid interface port with a constant depth that is substantially smaller than the diameter of the fluid interface port, as recited in independent claims 1, 9, 20, 42, 64, 66 and 70. The recited fluid interface ports thus have a disk shape, as shown in Figures 2A and 2B, and described on page 17, lines 19-20, to facilitate direct access to the channel interior, a feature not taught or suggested in the cited references. The recited shape is not merely a design choice, but rather an inventive feature specifically intended to form a virtual wall that creates minimal dead volume and enables presence of the fluid interface port to have no effect on the fluid flow in the microchannel, in contrast to the changes in fluid flow created in the ports of the cited references.

In addition, the cited references, alone or in any combination, fail to disclose a fluid interface port forming a virtual wall that replaces a removed portion of a side wall, or a meniscus surface that is co-planar with a side wall of a channel.

The Heller reference shows an application area having fluid from a filled microchannel entering into the application area, in contrast to the claimed invention. Heller particularly discusses the advantages of an enlarged application area A in the injection channels in terms of sample loading accuracy in column 5, lines 32-35, which teaches *away* from a fluid interface port having minimal size and dead volume, which could provide decreased loading accuracy due to the small size. The enlarged application area A result in liquid in the injection channels entering the application area when the injection channels are filled, creating a large, non-zero dead volume. Therefore, the reference requires some of the fluid to enter the fluid interface port, in direct contrast to the claimed invention.

The Amigo and McCormick references also fail to disclose a filled microchannel having fluid sealed therein by a meniscus of a fluid interface port, which prevents fluid filling the microchannel from entering the fluid interface port from the microchannel, as required by the claimed invention.

The Howitz reference also teaches away from sealing a fluid in the interior of a microchannel and preventing a fluid from entering a fluid interface port. For example, the Howitz reference, in the sixth paragraph of the specification (column 1), specifies that "the length of each individual microcapillary is to be selected such that the target fluid will spread up to the capillary ends", with a "meniscus at the end of each microcapillary". In addition, the Howitz references relies on diffusion and/or convection mechanisms to mix a second liquid passing into the microcapillary with a first liquid into the flow channel, which requires a sufficient amount of target fluid in the microcapillary. The Howitz reference therefore requires a substantial amount of dead volume in each microcapillary, precluding formation of a virtual wall with minimal dead volume, in contrast to the claimed invention.

The Columbus '313 reference and the Bjornson reference also do not disclose a fluid interface port that prevents liquid filling an associated microchannel from entering into the fluid interface port. Columbus '313 describes apertures having a relatively long length and size, requiring fluid from an associated channel to enter therein and resulting in a dead volume that is significantly **larger** than zero. For example, on page 9, lines 6-8, the Columbus '313 reference indicates that it is preferable for a liquid ingress aperture 27b in a flow control bridge to have a diameter of about 0.25 centimeters, which would result in a relatively large dead volume. In addition, the apertures 27 have a depth that is substantially larger than a diameter, resulting in a channel shape, in contrast to the claimed fluid interface ports, which have a disk shape.

The Bjornson reference also does not disclose a virtual wall fluid interface port that seals fluid in a microchannel and prevents fluid in the microchannel from entering the port. The aperture 630 of Bjornson does not have a diameter that is substantially larger than a depth to create a disk-shaped aperture, as recited in independent claims 9 and 20. Moreover, in Bjornson, liquid in the reservoir 56 is forced out via the aperture 630 and into reservoir 142, in contrast to the claimed invention, which utilizes virtual wall fluid interface ports to inject fluid into a

channel. The Bjornson reference does not disclose a fluid interface port in a side wall of a microchannel. Rather, the aperture 630 is formed in a reservoir 56 in Bjornson. There is no suggestion that the structure described in Bjornson would be suitable in a microchannel.

The Columbus '451 reference also does not disclose a fluid interface port in a microchannel filled with a fluid, where none of the fluid in the microchannel enters the fluid interface port. The liquid inlet aperture 46 in Columbus '451 also has a depth that is larger than the diameter, in contrast to the claimed invention. As specifically set forth in column 5, lines 29-34, the liquid inlet aperture 46 has a diameter of between about 1.0 mm and about 5.0 mm, preventing sealing of the fluid within an interior of an associated microchannel and resulting in a dead volume many times larger than one picoliter, and is incapable of forming a virtual wall, as required by the claimed invention.

The Sundberg reference also teaches away from the claimed invention. Figure 3 of Sundberg specifically illustrates ports 34 that are substantially filled with liquid 50, with the liquid held in the port 34 by capillary force, in clear contrast to the claimed invention, where no liquid enters into and is held by the port. Rather, the claimed fluid interface port seals the liquid inside the microchannel, outside of the fluid interface port, unlike the Sundberg reference.

None of the cited references disclose a fluid interface port capable of forming a virtual wall. The virtual wall forms a *direct* interface between the microchannel interior and the microchannel exterior, allowing direct access to the liquid in microchannel without introducing dead or unswept volume in the microchannel. The dimensions are particularly selected to create the intended effect. Even if the devices in the cited references were capable of forming menisci, the menisci would not form virtual walls to allow a direct interface between the microchannel interior and the microchannel exterior, allowing direct access to the liquid in microchannel without introducing dead or unswept volume in the microchannel. In contrast, the channels in the Heller reference, the McCormick reference, the Amigo reference, the Howitz reference, the Columbus '313 reference, the Columbus '451 reference, the Bjornson reference, the Swedberg reference and the Sundberg reference do not directly interface a microchannel to the environment surrounding the device. These channels also do not form a direct interface, but rather a long, indirect opening with a large dead volume.

The particular dimensions of the claimed fluid interface port define a structure that allows the claimed device to perform in a particular manner not disclosed in the prior art. In fact, were the interfacing components in the cited references to have the claimed dimensions, the operation of the prior art devices would be significantly altered.

As described above, all pending claims distinguish patentably over the cited references taken either alone or in any combination. For at least these reasons, Applicants request that the rejections under 35 U.S.C. §103 be reconsidered and withdrawn. For at least the foregoing reasons, claims 1-14 and 16-45, 46-64 and 66-70 are patentable over the cited references and in condition for allowance.

CONCLUSION

In view of the above amendment, applicant believes the pending application is in condition for allowance. If a telephone conversation with Applicants' attorney would help expedite the prosecution of the above-identified application, the Examiner is urged to call the undersigned attorney at (617) 227-7400.

If any additional fee is due with this statement, please charge our Deposit Account No. 12-0080, under Order No. TGZ-001BRCE3, from which the undersigned is authorized to draw.

Dated: August 7, 2008

Respectfully submitted,

Electronic Signature: /David R. Burns/
David R. Burns
Registration No. 46,590
LAHIVE & COCKFIELD, LLP
One Post Office Square
Boston, Massachusetts 02109
(617) 227-7400
(617) 742-4214 (Fax)
Attorney for Applicants